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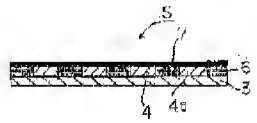
(54) SURFACE ACOUSTIC WAVE DEVICE AND MANUFACTURE THEREFOR



(57)Abstract:
PROBLEM TO BE SOLVED: To prevent electrode short-circuiting or the like and characteristic degradation by discharge between electrode fingers and to improve reliability by forming an insulating or semi-conductive inter-electrode-finger film between the electrode fingers of an excitation electrode and forming an insulating or semi-conductive protective film on the excitation electrode and on the inter-electrode-finger film.
SOLUTION: Between the electrode fingers 4a of an IDT electrode 4 which is the excitation electrode at least on a piezoelectric substrate 3, the insulating or semi- conductive inter-electrode-finger film 6 whose specific resistance value is not less than 10-3 Ωcm for instance is formed. Thereafter, the insulating or semi-conductive protective film 7 is put on and formed at least in an electrode area. In such a manner, by putting on and forming the inter-electrode-finger film 6 provided with a

film thickness almost equal to an IDT electrode film thickness between the electrodes before putting on and forming the protective film 7, the coverage of an electrode side face part at the time of forming the protective film 7 thereafter is improved. Thus, the degradation of the electrode short-circuiting or the like by the attachment of conductive foreign matters is eliminated and the characteristic degradation by the discharge between the electrode fingers due to pyroelectricity provided in the piezoelectric substrate 3 is eliminated as well.

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CLAIMS

[Claim(s)]
[Claim 1] Surface acoustic wave equipment characterized by having formed the insulating or semi-conductive electrode finger mesenteriolum between the electrode fingers of said excitation electrode, and forming an insulating or semi-conductive protective coat on said excitation electrode and said electrode finger mesenteriolum in the surface acoustic wave equipment which prepares a ctenidium-like excitation electrode and changes on a piezo-electric substrate.
[Claim 2] Said excitation electrode and the electrode finger mesenteriolum are surface acoustic wave equipment according to claim 1 characterized by having made the metal membrane formed on said piezo-electric substrate anodize alternatively, and forming it.
[Claim 3] The process which forms an insulator layer or the semi-conductive film on a piezo-electric substrate, and the process which forms a photoresist pattern on said insulator layer or the semi-conductive film, The process which carries out patterning of said insulator layer or the semi-conductive film by using this photoresist pattern as a mask, and forms the electrode finger mesenteriolum, The process which forms a metal membrane on said photoresist pattern and a piezo-electric substrate, The manufacture approach of the surface acoustic wave equipment characterized by including the process which forms the excitation electrode which consists of said metal membrane by removing said photoresist pattern, and the process which forms an insulating or semi-conductive protective coat on said excitation electrode and said electrode finger mesenteriolum at least.
[Claim 4] The process which forms a metal membrane on a piezo-electric substrate, and the process which forms a photoresist pattern on said metal membrane, The process which carries out patterning of said metal membrane by using this photoresist pattern as a mask, and forms an excitation electrode, The process which forms an insulator layer or the semi-conductive film on said piezo-electric substrate and said photoresist pattern, The manufacture approach of the surface acoustic wave equipment characterized by including the process which forms the electrode finger mesenteriolum which removes said photoresist pattern and consists of an insulator layer or the semi-conductive film, and the process which forms an insulating or semi-conductive protective coat on said excitation electrode and said electrode finger mesenteriolum at least.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to surface acoustic wave equipments, such as a surface acoustic wave filter which prepares an excitation electrode in the piezo-electric substrate which consists of single crystals, such as lithium tantalate, lithium niobate, and a tetraboric acid lithium, and grows into it.
[0002]
[Description of the Prior Art] In recent years, many surface acoustic elements are used as components, such as a filter of the electronic equipment using an electric wave, the delay line, and a transmitter. Especially the small and lightweight surface acoustic wave filter with the high steep cutoff engine performance as a filter is used abundantly in the mobile communications field as a filter of RF stage of personal digital assistant equipment, and IF stage, and the reliable surface acoustic wave filter with good and engine performance, such as an insertion loss and the magnitude of attenuation out of band, is demanded.
[0003] However, while requiring high-reliability, detailed-ization of the electrode line breadth of a surface acoustic wave filter and an electrode spacing is progressing with RF-izing of mobile communication system, and it is becoming very detailed electrode line breadth and electrode spacing of several microns - about 0.5 microns in current.
[0004] For this reason, it set like the erector after a wafer process, and on the ctenidium-like electrode, the electrode short-circuit by conductive detailed foreign matter adhesion etc. became a cause, and the problem that a yield fell remarkably was.
[0005] Moreover, also in the finished product mounted in the package, according to generating of the detailed foreign matter out of the package by vibration etc., the defect of a cause occurred and electrode

short-circuit had become a big problem in respect of dependability.
[0006] Since a detailed foreign matter tends to have adhered that static electricity tends to generate especially piezo-electric substrates used for a surface acoustic wave filter, such as lithium niobate and lithium tantalate, by the pyroelectricity, even if it managed severely the cleanliness in the environment which is like [erector], and a package, the present condition was that sufficient cure does not become.
[0007] Moreover, when it was put on the bottom of an environment hot in the condition that the erector was used for the device and the rapid temperature change was given by this pyroelectricity, uneven charge distribution arose on the piezo-electric substrate, and it carried out that an electrode deformed by the discharge which this became a cause and was generated etc., as a result there was a problem of inducing degradation of a filter shape etc.
[0008] That is, in processes at the time of package mounting after electrode formation of a ctenidium-like excitation electrode etc., such as die bonding and wire bonding, if a piezo-electric substrate is put on the bottom of elevated temperature about 80 degrees C or more, charge distribution will arise on a piezo-electric substrate front face by the pyroelectricity of a piezo-electric substrate. And although the charge produced on this piezo-electric substrate front face is neutralized by the suspension charge in air etc., this rate neutralized will change with configurations, area, etc. of an electrode which were formed on the piezo-electric substrate, and uneven density-of-electric-charge distribution will exist in some places on a piezo-electric substrate. Very big electric field will be impressed in the narrow part of the gap of the electrode finger of a ctenidium-like electrode and electrode finger which constitute as a result, for example, an excitation electrode. Discharge took place so that the above-mentioned density-of-electric-charge distribution might be eased, the electrode finger of an excitation electrode deformed by this discharge, or it carried out that a part fused and exfoliated etc., for example, the filter shape deteriorated, and the piece of a metal which exfoliated adhered on electrodes, such as an excitation electrode, and it had caused short [poor].
[0009] The electrode short-as means to solve these problems conventionally prevention by conductive foreign matter adhesion of a up to [an electrode], Furthermore, for the purpose of electrostatic-discharge prevention of the electrode at the time of the temperature change by the pyroelectricity of a substrate The approach of being and forming a semi-conductive protective coat that it was insulating on

electrodes, such as a ctenidium-like excitation electrode, was proposed, however (for example, Japanese Patent Application No. No. 320521 [eight to]) as shown in drawing 9 by the above-mentioned approach Although the electrode finger 52a top of the excitation electrode 52 of the shape of a ctenidium formed on the piezo-electric substrate 51 and the protective coat 54 of thickness with sufficient 53 between electrode fingers are formed The lateral portion 55 of electrode finger 52a could form only the very thin protective coat, but had become the protective coat which is not locally connected depending on the case, and had become the protective coat which is carrying out the stage piece completely. This has the large direction dependency to which a membrane formation particle adheres also in the membrane formation approaches that vacuum deposition and step coverage are made comparatively good, such as a spatter, and the lateral portion 55 of electrode finger 52a is hard to form a protective coat compared with substrate 51 top face or an electrode finger 52a top face.

[0010]

[Problem(s) to be Solved by the Invention] Thus, by the conventional approach, since the coverage of the protective coat in an electrode finger lateral portion was bad, when the conductive foreign matter adhered between electrode fingers (clearance), the short-circuit between electrode fingers occurred, and there was a problem that it was not property degradation prevention at the time of sufficient conductive foreign matter adhesion of a certain thing of effectiveness from a thing without a protective coat.

[0011] Moreover, in order to prevent degradation of the filter shape by discharge between the electrode fingers which originate in ununiformity distribution of the charge mentioned above, and are generated etc. Since the semi-conductive protective coat is not fully connected in an electrode lateral portion when a protective coat semi-conductive for the purpose which makes ununiformity distribution of the generated charge ease is formed, The conductivity of the protective coat in an electrode lateral portion was bad, the effectiveness of making ununiformity distribution of a charge easing became small, and there was a problem that degradation of a filter shape could not fully be prevented.

[0012] Although how to form a protective coat thickly is also considered as a means to solve the above-mentioned problem, if the protective coat on an electrode is thickened, degradation to filter shapes, such as loss, becomes large and is not practical.

[0013] It aims at offering the surface acoustic wave equipment which was very excellent in the dependability which this invention was made in

order to cope with such a technical problem, and it does not have degradation of the electrode short-circuit by conductive foreign matter adhesion etc., and does not have property degradation by discharge between the electrode fingers resulting from the pyroelectricity which a piezo-electric substrate has.

[0014]

[Means for Solving the Problem] The surface acoustic wave equipment of this invention which attains the above-mentioned purpose is characterized by having formed the insulating or semi-conductive electrode finger mesenteriolum between the electrode fingers of an excitation electrode, and forming an insulating or semi-conductive protective coat on an excitation electrode and the electrode finger mesenteriolum in the surface acoustic wave equipment which prepares a ctenidium-like excitation electrode and changes on a piezo-electric substrate.

[0015] Moreover, it is characterized by having made the metal membrane in which an excitation electrode and the electrode finger mesenteriolum were formed on the piezo-electric substrate anodize alternatively, and forming it.

[0016] Moreover, the manufacture approach of the surface acoustic wave equipment of this invention The process which forms an insulator layer or the semi-conductive film on a piezo-electric substrate, and the process which forms a photoresist pattern on an insulator layer or the semi-conductive film, The process which carries out patterning of an insulator layer or the semi-conductive film by using this photoresist pattern as a mask, and forms the electrode finger mesenteriolum, The process which forms a metal membrane on a photoresist pattern and a piezo-electric substrate, It is characterized by including the process which forms the excitation electrode which consists of a metal membrane, and the process which forms an insulating or semi-conductive protective coat on an excitation electrode and the electrode finger mesenteriolum at least by removing a photoresist pattern.

[0017] Moreover, the process which forms a metal membrane in a piezo-electric substrate and the process which forms a photoresist pattern on a metal membrane, The process which carries out patterning of the metal membrane by using this photoresist pattern as a mask, and forms an excitation electrode, The process which forms an insulator layer or the semi-conductive film on a piezo-electric substrate and a photoresist pattern, It is characterized by including the process which forms the electrode finger mesenteriolum which removes a photoresist pattern and consists of an insulator layer or the semi-conductive film, and the

process which forms an insulating or semi-conductive protective coat on an excitation electrode and the electrode finger mesenteriolum at least.
[0018] In addition, with insulation or semi-conductivity, resistivity considers as the thing more than 10-3ohmcm. Moreover, in the above-mentioned surface acoustic wave equipment, the coverage of the electrode side face at the time of subsequent protective coat formation can be raised by forming the film (inter-electrode film) which has electrode layer thickness and the thickness of an abbreviation EQC in inter-electrode before protective coat formation.
[0019]
[Embodiment of the Invention] Hereafter, the gestalt of the operation concerning this invention is explained to a detail based on a drawing. As shown in drawing 1 , although it consists of two or more surface acoustic wave resonators 2 by which parallel connection was carried out to two or more surface acoustic wave resonators 1 by which series connection was carried out, especially, the surface acoustic wave equipment S of this invention is not limited to such a ladder mold filter, and a lattice mold filter etc. is sufficient as it, for example, it can be applied to an SAW filter, a SAW resonator, etc. of various configurations and a connection mode.
[0020] The surface acoustic wave equipment S of drawing 1 constitutes a low pass filter as it is also with two or more surface acoustic wave resonators 1 by which series connection was carried out, it constitutes a high-pass filter as it is also with the surface acoustic wave resonator 2 by which parallel connection was carried out, and it acquires a desired property.
[0021] As shown in drawing 2 , moreover, the surface acoustic wave resonators 1 and 2 Respectively Piezo-electric substrates, such as a lithium tantalate single crystal, a lithium niobate single crystal, or a tetraboric-acid lithium single crystal (It is also only hereafter called a substrate) While arranging the IDT electrode 4 which is an excitation electrode of the shape of a ctenidium which consists of the alloys (an aluminum-Si system, an aluminum-Cu system, aluminum-Ti system, etc.) which use aluminum and aluminum as a principal component on three The reflector 5 which changes from the IDT electrode 4 and the same quality of the material to the both ends of the IDT electrode 4 is arranged, respectively, and it is made to make the surface acoustic wave of wavelength lambda spread in the direction of X. In addition, in drawing 2 R> 2, since it is easy, in order to show the IDT electrode 4 and a reflector 5 clearly, the electrode finger mesenteriolum and protective coat which carry out a postscript are omitted.

[0022] Moreover, as shown in the fragmentary sectional view of the IDT electrode 4 at drawing 3 and drawing 4 , after [on the piezo-electric substrate 3] resistivity forms the electrode finger mesenteriolum 6 insulating [more than 10-3ohmcm], or semi-conductive among electrode finger 4a of the IDT electrode 4 at least, covering formation of the insulating or semi-conductive protective coat 7 is carried out to the electrode field at least.
[0023] Thus, before carrying out covering formation of the protective coat 7, the coverage of the electrode lateral portion at the time of formation of the subsequent protective coat 7 can be raised by carrying out covering formation of the electrode finger mesenteriolum 6 which has IDT electrode layer thickness and the thickness of an abbreviation EQC in inter-electrode. And thereby, there is no degradation of the electrode short-circuit by conductive foreign matter adhesion etc., and the surface acoustic wave equipment without property degradation by discharge between the electrode fingers resulting from the pyroelectricity which the piezo-electric substrate 3 has which was very excellent in dependability can be realized.
[0024] After drawing 3 sticks the electrode finger mesenteriolum 6 with electrode finger 4a of both sides and forms it, it carries out covering formation of the protective coat 7 to an electrode field. Since prevention of the electrode short-circuit by conductive foreign matter adhesion of a between [electrode fingers] serves as a role of a protective coat 7 when there is almost no pyroelectricity like for example, a tetraboric acid lithium crystal substrate in the piezo-electric substrate 3 used, there are not the electrode finger mesenteriolum 6 and a protective coat 7, and they can make insulation the need of being semi-conductivity.
[0025] Moreover, although insulating or semi-conductive any are sufficient as the electrode finger mesenteriolum 6, by using a protective coat 7 as the semi-conductive film at least, the case of the substrate with which the piezo-electric substrate 3 used has pyroelectricity like for example, a lithium-niobate crystal substrate and a lithium tantalate substrate makes the ununiformity of the charge distribution generated between electrode fingers by a temperature change etc. ease, and can prevent degradation of the filter shape by discharge etc.
[0026] Although it is easily realizable with alternative anodic oxidation of a metal thin film, the structure which stuck electrode finger 4a and the electrode finger mesenteriolum 6 is an effective approach when making an insulator layer into the electrode finger

mesenteriolum 6, since the electrode finger mesenteriolum 6 serves as a metallic oxide in this case. Since electrode finger 4a and the electrode finger mesenteriolum 6 are especially formed from much more metal membrane, it excels in the surface smoothness before membrane formation of a protective coat 7, and a protective coat 7 can be formed by very good covering nature.

[0027] Formation of the metallic oxide by the above-mentioned anodic oxidation is performed by the approach as shown for example, in drawing 5 (a) - (c). That is, as shown in drawing 5 (a), the substrate 3 with which the photoresist (photoresist pattern) 8 by which patterning was carried out to the metal thin film 40 was formed into the container 12 which filled the electrolytic solution 11 is immersed, the metal electrodes 14, such as platinum, are connected to an anode plate, respectively, and the metal thin film 40 on a substrate 3 is made to counter the cathode of DC power supply 13 with a substrate 3. And by energizing a direct current, the field which is not covered with the photoresist resist 8 on the metal thin film 40 on a substrate 3 is oxidized, and the electrode finger mesenteriolum 6 which consists of an oxide film as shown in drawing 5 (b) is formed. Then, as shown in drawing 5 (c), for example, the semi-conductive film is formed by vacuum evaporationo etc., and a protective coat 7 is formed.

[0028] In addition, depending on the class of an electrode design and piezo-electric substrate, and an operating environment, it may be easy to generate discharge by the charge ununiformity. In this case, by using the electrode finger mesenteriolum 6 as the semi-conductive film, the still higher prevention effectiveness is expectable to property degradation by discharge rather than it uses only a protective coat 7 as the semi-conductive film.

[0029] In addition, in the structure of drawing 3 , when using the electrode finger mesenteriolum 6 as the semi-conductive film, it can realize by repeating photolithography and etching twice, as shown in drawing 8 again. That is, it is realizable by the production process as shown in drawing 8 . First, as shown in drawing 8 (a), a metal membrane 40 is formed on the piezo-electric substrate 3, and the photoresist 8 which carried out patterning is formed on it. Next, as shown in drawing 8 (b), the metal membrane which is not covered by the photoresist 8 is removed, further, as shown in drawing 8 (c), a photoresist 8 is removed and the IDT electrode 4 is formed. And as shown in drawing 8 (d), covering formation of the semi-conductive film 60 is carried out on the piezo-electric substrate 3 and the IDT electrode 4, and as shown in drawing 8 (e), after forming a photoresist 8 in the whole surface, as

shown in drawing 8 (f), photolithography removes the photoresist 8 on the semi-conductive film 60 alternatively. And as shown in drawing 8 (g), by performing dry etching etc. by using as a mask the photoresist left behind alternatively, the semi-conductive film 60 on the IDT electrode 4 is removed, and as a photoresist 8 is removed and it is shown in drawing 8 (i), subsequently to drawing 8 (h), the semi-conductive protective coat 7 is formed in the whole surface, so that it may be shown. However, while a process becomes complicated, as for this approach, the alignment of a highly precise photo mask and a highly precise etching technique are needed.

[0030] Then, as shown in drawing 6 , after forming the electrode finger mesenteriolum by etching by using a photoresist pattern as a mask, the surface acoustic wave equipment of the structure of drawing 4 can be easily obtained by forming the electrode finger of an IDT electrode by the lift-off method using the same photoresist pattern, and finally forming a protective coat all over an electrode field.

[0031] That is, as shown in drawing 6 (a), after forming the semi-conductive film 60 by vacuum evaporationo etc. to one principal plane of the piezo-electric substrate 3 first, a photoresist 8 is applied to the whole surface and photolithography performs patterning of a photoresist 8. Next, as shown in drawing 6 (b), by wet etching or dry etching, semi-conductive film 60 other than the covering section of a photoresist 8 is removed, and the electrode finger mesenteriolum 6 is formed. Next, as shown in drawing 6 (c), metal membranes 4 and 40 are formed with vacuum deposition etc., the metal membrane 40 on a photoresist 8 is removed after an appropriate time with exfoliation of a photoresist 8, and the IDT electrode 4 (electrode finger) is formed in it among electrode finger mesenteriolum 6. And as shown in drawing 6 (d), a protective coat 7 is formed with vacuum deposition etc. on the piezo-electric substrate 3, the excitation electrode 4, and the semi-conductive electrode finger mesenteriolum 6.

[0032] Thus, because 1 time of photolithography can perform patterning of an electrode finger and the electrode finger mesenteriolum and the alignment of an electrode finger and the electrode finger mesenteriolum serves as a self-alignment method, it becomes the very simple manufacture approach by combining the etching method and the lift-off method.

[0033] In order to produce an electrode finger by the lift-off method, it is necessary to make width of face of the electrode finger mesenteriolum smaller to about 0.1 microns or less than the width of face of a resist which serves as a mask as shown in drawing 6 (b) at the

time of the electrode finger mesenteriolum formation by etching of the preceding paragraph story.
[0034] It is possible to form by this, the good protective coat which can fill a gap enough since the thickness of a protective coat 4 is about 0.02-0.07 microns, and does not have a stage piece, although an about 0-0.1-micron gap is generated between an electrode finger and the electrode finger mesenteriolum.
[0035] Drawing 7 is the manufacture approach which forms an electrode finger by etching and forms the electrode finger mesenteriolum by the lift-off method, and is theoretically the same as the case of drawing 6 .
[0036] that is, first, as shown in drawing 7 (a), on the piezo-electric substrate 3, covering formation was carried out and patterning of the metal membrane 40 was carried out after that on the whole surface -- it forms photoresist 8. Next, as shown in drawing 7 (b), etching removal of the field which is not covered by the photoresist 8 of a metal membrane 40 is carried out, and the ctenidium-like IDT electrode 4 is formed. And as shown in drawing 7 (c), the semi-conductive film 6 and 60 is formed on a photoresist 8 and the piezo-electric substrate 3, and the electrode finger mesenteriolum 6 is formed. Furthermore, on the IDT electrode 4, as by removing a photoresist 8 by the lift-off method shows to drawing 7 (d), although it reached on the electrode finger mesenteriolum 6 and not being illustrated, a protective coat 7 is formed on the piezo-electric substrate 3.
[0037] In the manufacture approach shown in drawing 6 and drawing 7 , it is obvious for the electrode finger mesenteriolum and a protective coat to be able to form by the insulator layer or the semi-conductive film independently, respectively.
[0038] As an insulator layer used for such electrode finger mesenteriolum and a protective coat, an oxide or nitrides, such as silicon oxide, silicon nitride, and an aluminum oxide, can be used. Moreover, the ingredient whose ratio (resistivity / electrode layer thickness) of specific resistance and electrode layer thickness is 109-1013ohms as semi-conductive film is desirable, and a silicone film (specific resistance 5x105 omega-cm extent) is used well.
[0039] Thus, the surface acoustic wave equipment which was very excellent in the dependability which does not have degradation of the electrode short-circuit by conductive foreign matter adhesion etc., and does not have property degradation by discharge between the electrode fingers resulting from the pyroelectricity which a piezo-electric substrate has can be offered by the simple manufacture approach.
[0040] In addition, surface acoustic wave equipment is not what is

limited to an above-mentioned gestalt and an above-mentioned process. Electrodes, such as an excitation electrode, are arranged on a piezo-electric substrate, and the insulating or semi-conductive electrode finger mesenteriolum is formed between the electrode fingers of an excitation electrode. Furthermore, that the protective coat should just be formed on an excitation electrode and the electrode finger mesenteriolum at least, it is not limited to the above-mentioned thing about the quality of the materials, such as a piezo-electric substrate, an excitation electrode, electrode finger mesenteriolum, and a protective coat, but can carry out by changing suitably in the range which does not deviate from a summary.

[0041]

[Example] [Example 1] Explain the example of a configuration as shown in drawing 3 first. It is 1-1.5 micrometers in thickness on the piezo-electric substrate with which approaches, such as vacuum evaporationo and a spatter, were used, metal thin films, such as aluminum and an aluminium alloy, were formed in about 2000-5000A in thickness, and the metal thin film was formed in one field of a piezo-electric substrate with a diameter [of 36 degreeY cut X propagation lithium tantalate] of about 3-4 inches in the photoresist after that. It applied to extent. It exposed by ultraviolet radiation etc. using the photo mask which can form an electrode pattern in after an appropriate time.

[0042] Next, as it was immersed in the developer of an organic alkali system, and patterning of a photoresist was performed, next it was shown in drawing 5 (a), the substrate 3 was immersed into the container 12 which filled the electrolytic solution 11. The metal thin film 40 on a substrate 3 was connected to the cathode of DC power supply 13, the metal electrodes 14, such as platinum, were connected to the anode plate, and it was made to counter with a substrate 3. And current density 0.1 - 2 A/dm2 By energizing the direct current of extent, the field which is not covered with the photoresist resist 8 on the metal thin film 40 on a substrate 3 was oxidized, and the electrode finger mesenteriolum 6 which consists of an oxide film of an aluminum oxide as shown in drawing 5 (b), or an aluminium alloy was formed in about 2000-5000A in thickness.

[0043] Here, the solution which consists of ethylene glycol and tetraboric acid ammonium, the sulfuric acid, the chromic acid, etc. were used for the electrolytic solution 11. Then, as shown in drawing 5 (c), vacuum evaporationo etc. performed membrane formation with a thickness of about 200-700A for the silicone film, and the protective coat 7 was formed.

[0044] Next, partial etching by photolithography etc. removed the

protective coat of the wire bonding pad section, and the SAW filter was completed after that through the mounting process to packages, such as dicing, die bond, wire bond, and the closure. This SAW filter had the very good insertion loss few, and in the state of the chip, to the conductive paste, in the characterization after immersing and drying, degradation was not looked at by the property at all, but it has fully demonstrated the function as a protective coat. Furthermore, degradation was not seen by rapid temperature changes, such as an erector degree,, either, but property degradation by discharge has been prevented completely.

[0045] [Example 2] Next, explain the example of a configuration as shown in drawing 4 . As shown in drawing 6 (a), after forming a silicone film 60 in thickness of about 2000-5000A by vacuum evaporationo etc. in one field of the piezo-electric substrate 3 of a 36 degreeY cut X propagation lithium tantalate single crystal, photolithography performed patterning of a photoresist 8.

[0046] Next, as shown in drawing 6 (b), by the dry etching by wet etching or fluoridation carbon (CF4) of fluoric acid and a nitric-acid system etc., silicone films other than the covering section of a photoresist 8 were removed, and the electrode finger mesenteriolum 6 was formed in about 2000-5000A in thickness.

[0047] Next, as shown in drawing 6 (c), membrane formation 2 and 20 of aluminum or an aluminium alloy was performed, the aluminum film 40 on a photoresist 8 was removed with exfoliation of a photoresist 8, and the IDT electrode 4 (electrode finger) was formed in about 2000-5000A in thickness among electrode finger mesenteriolum 6. After that, the silicon protective coat 7 was formed like the above-mentioned example 1, and the SAW filter was completed through the mounting process. The effectiveness as Example 1 also with this same SAW filter was acquired.

[0048]

[Effect of the Invention] As explained in full detail above, according to the surface acoustic wave equipment of this invention, even if a conductive foreign matter adheres, there is no degradation of electrode short-circuit etc., and the surface acoustic wave equipment which property degradation by discharge between the electrode fingers resulting from the pyroelectricity which a piezo-electric substrate has does not have, either and which was very excellent in dependability can be offered by the simple and quick manufacture approach.

[0049] Moreover, if the electrode finger mesenteriolum is formed by anodic oxidation, since it not only can manufacture quickly, but it can form an electrode finger and the electrode finger mesenteriolum in

coincidence from much more metal membrane and the surface smoothness before protective coat formation will become good, the surface acoustic wave equipment with the protective coat which realized suitable covering nature which was very excellent in dependability can be offered.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram which explains typically the surface acoustic wave equipment of one example concerning this invention.
[Drawing 2] It is the outline top view which explains typically the surface acoustic wave resonator which constitutes the surface acoustic wave equipment concerning this invention.
[Drawing 3] It is drawing which explains typically 1 operation gestalt of the surface acoustic wave equipment concerning this invention, and is an A-A line part part sectional view in drawing 2 .
[Drawing 4] It is the fragmentary sectional view which explains typically other operation gestalten of the surface acoustic wave equipment concerning this invention.
[Drawing 5] (a) - (c) is a fragmentary sectional view which explains the 1 manufacture approach of this invention typically, respectively.
[Drawing 6] (a) - (d) is a fragmentary sectional view which explains other manufacture approaches of this invention typically, respectively.
[Drawing 7] (a) - (d) is a fragmentary sectional view which explains other manufacture approaches of this invention typically, respectively.
[Drawing 8] (a) - (i) is a fragmentary sectional view which explains typically the manufacture approach for comparing with this invention, respectively.
[Drawing 9] It is the fragmentary sectional view which explains an

example of conventional surface acoustic wave equipment typically.

[Description of Notations]

1: Surface acoustic wave resonator (for serials)
2: Surface acoustic wave resonator (for juxtaposition)
3: Substrate (piezo-electric substrate)
4: IDT electrode (excitation electrode)
4a: Electrode finger
5: Reflector
6: Electrode finger mesenteriolum
7: Protective coat
8: Photoresist
40: Metal membrane
S ... Surface acoustic wave equipment

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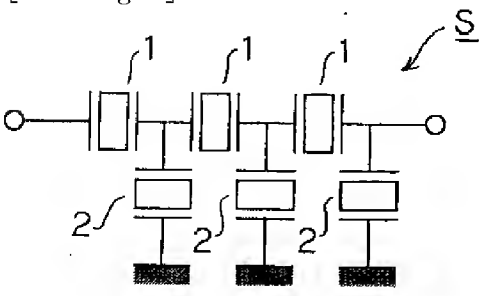
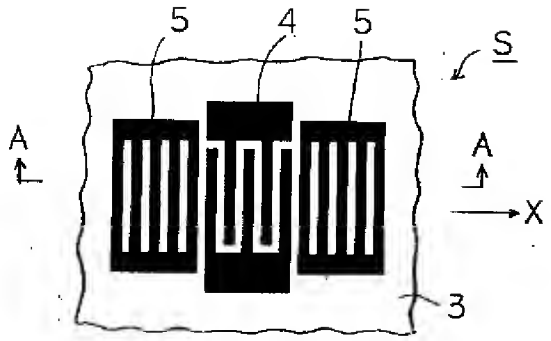
DRAWINGS

[Drawing 1]



[Drawing 2]



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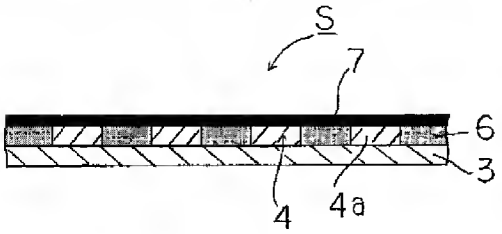
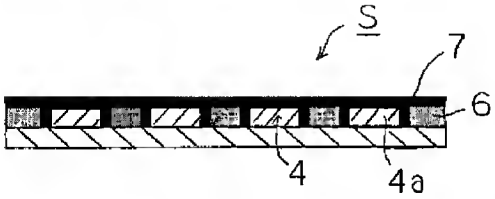
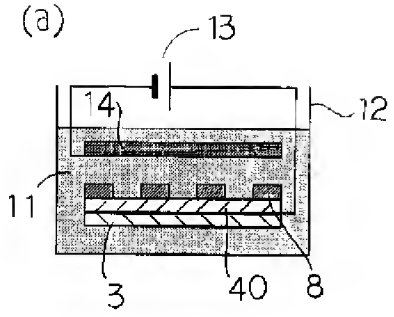


[Drawing 4]

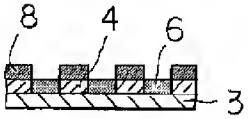


[Drawing 5]

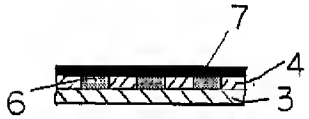
(a)



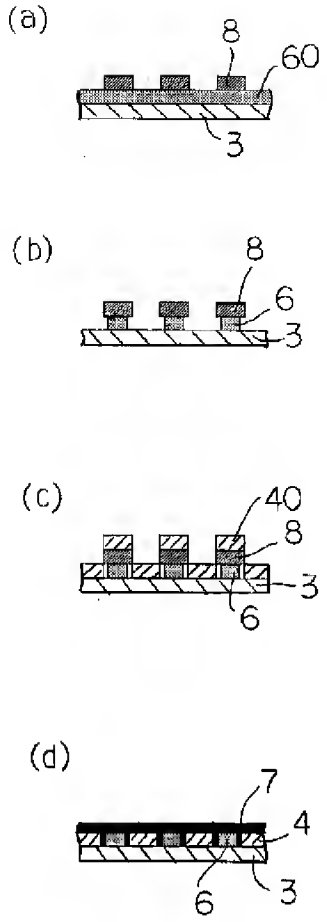
(b)



(c)

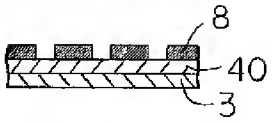


[Drawing 6]

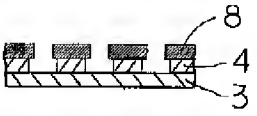


[Drawing 7]

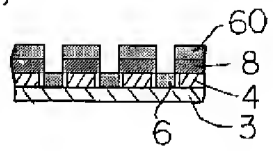
(a)



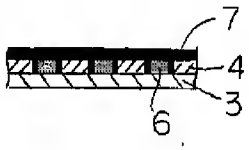
(b)



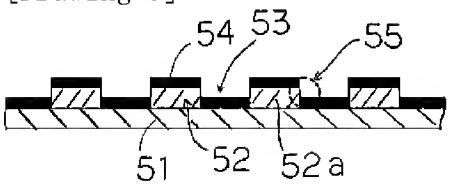
(c)



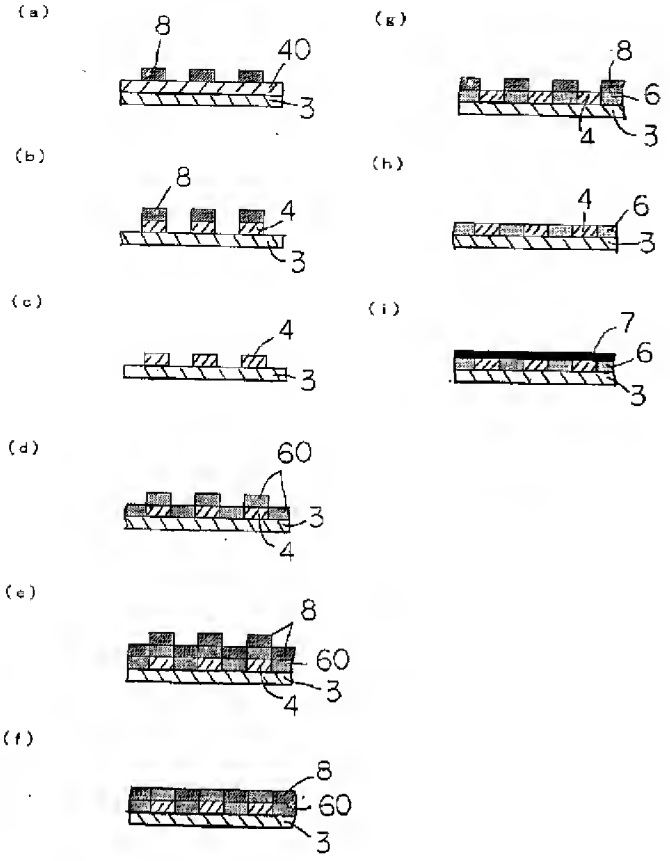
(d)



[Drawing 9]



[Drawing 8]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平11－186866

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(51)Int.Cl.[6]	識別記号	ＦＩ		
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3/08			3/08	

審査請求　未請求　請求項の数４　ＯＬ　（全　８　頁）

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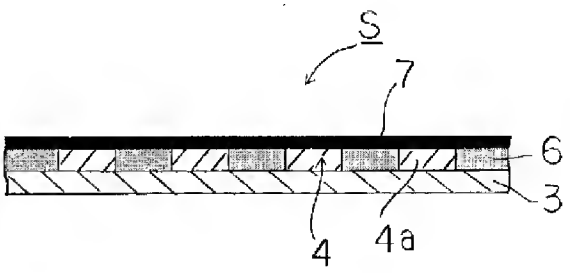
(54)【発明の名称】　弾性表面波装置及びその製造方法

(57)【要約】

【課題】　導電性異物付着による電極ショート等の劣化が無く、圧電基板のもつ焦電性に起因する電極指間の放電による特性劣化の無い信頼性の非常に優れた弾性表面波装置を提供すること。

【解決手段】　圧電基板３上に櫛歯状の励振電極４を設けて成る弾性表面波装置Ｓにおいて、励振電極４の電極指４ａ間に絶縁性または半導電性の電極指間膜６を形成し、励振電極４上及び電極指間膜６上に絶縁性または半導電性の保護膜７を形成したことを特徴とする。



【特許請求の範囲】
【請求項１】　圧電基板上に櫛歯状の励振電極を設けて成る弾性表面波装置において、前記励振電極の電極指間に絶縁性または半導電性の電極指間膜を形成し、前記励振電極上及び前記電極指間膜上に絶縁性または半導電性の保護膜を形成したことを特徴とする弾性表面波装置。
【請求項２】　前記励振電極及び電極指間膜は、前記圧電基板上に形成した金属膜を選択的に陽極酸化せしめて形成したことを特徴とする請求項１に記載の弾性表面波装置。
【請求項３】　圧電基板上に絶縁膜または半導電性膜を形成する工程と、前記絶縁膜または半導電性膜上にフォトレジストパターンを形成する工程と、該フォトレジストパターンをマスクとして前記絶縁膜または半導電性膜をパターニングして電極指間膜を形成する工程と、前記フォトレジストパターン上及び圧電基板上に金属膜を形成する工程と、前記フォトレジストパターンを除去することにより前記金属膜から成る励振電極を形成する工程と、少なくとも前記励振電極上及び前記電極指間膜上に絶縁性または半導電性の保護膜を形成する工程とを含むことを特徴とする弾性表面波装置の製造方法。
【請求項４】　圧電基板上に金属膜を形成する工程と、前記金属膜上にフォトレジストパターンを形成する工程と、該フォトレジストパターンをマスクとして前記金属膜をパターニングして励振電極を形成する工程と、前記圧電基板上及び前記フォトレジストパターン上に絶縁膜または半導電性膜を形成する工程と、前記フォトレジストパターンを除去して絶縁膜または半導電性膜から成る電極指間膜を形成する工程と、少なくとも前記励振電極上及び前記電極指間膜上に絶縁性または半導電性の保護膜を形成する工程とを含むことを特徴とする弾性表面波装置の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、例えばタンタル酸リチウム，ニオブ酸リチウム，四ほう酸リチウム等の単結晶からなる圧電基板に、励振電極を設けて成る弾性表面波フィルタ等の弾性表面波装置に関するものである。
【０００２】
【従来の技術】近年、電波を利用する電子機器のフィルタ，遅延線，発信器等の素子として多くの弾性表面波素子が用いられている。特に小型・軽量でかつフィルタとしての急峻遮断性能が高い弾性表面波フィルタは、移動体通信分野において、携帯端末装置のＲＦ段及びＩＦ段のフィルタとして多用されるようになってきており、挿入損失や帯域外減衰量などの性能が良好で且つ信頼性の高い弾性表面波フィルタが要求されている。
【０００３】しかしながら、高信頼性を要求する一方で、移動体通信システムの高周波化に伴い弾性表面波フィルタの電極線幅及び電極間隔の微細化が進んでおり、現在では数ミクロン～０．５ミクロン程度の非常に微細な電極線幅及び電極間隔となってきている。
【０００４】このため、ウエハプロセス以降の組立工程においては、櫛歯状電極上に導電性の微細異物付着による電極ショート等が原因となり、著しく歩留が低下するという問題があった。
【０００５】また、パッケージに実装した完成品においても、振動等によるパッケージ内からの微細異物の発生により、電極ショートが原因の不良が発生し、信頼性面で大きな問題となっていた。
【０００６】特に、弾性表面波フィルタに用いるニオブ酸リチウムやタンタル酸リチウムなどの圧電基板は、その焦電性により静電気が発生し易く微細異物が付着し易いため、組立工程の環境及びパッケージ内の清浄度を厳しく管理しても十分な対策とはならないのが現状であった。
【０００７】また、この焦電性により、組立工程及び機器に使用された状態で高温の環境下に置かれ急激な温度変化が与えられると、圧電基板上に不均一な電荷分布が生じて、これが原因となって発生した放電で電極が変形する等して、ひいてはフィルタ特性の劣化等を誘発するという問題があった。
【０００８】すなわち、櫛歯状の励振電極等の電極形成後のパッケージ実装時におけるダイボンディングやワイヤーボンディング等の工程において、圧電基板が約８０℃以上の高温下に置かれると、圧電基板の焦電性により圧電基板表面に電荷分布が生ずる。そして、この圧電基板表面に生じた電荷は空気中の浮遊電荷等により中和されていくが、この中和されていく速度は圧電基板上に形成された電極の形状や面積等により異なり、所々に不均一な電荷密度分布が圧電基板上に存在することになる。その結果、例えば励振電極を構成する櫛歯状電極の電極指と電極指との間隙の狭い部分において非常に大きな電界が印加されることになり、上記電荷密度分布を緩和するように放電が起こり、この放電により励振電極の電極指が変形したり、一部が溶融して剥離するなどして、例えばフィルタ特性が劣化したり、剥離した金属片が励振電極等の電極上に付着してショート不良を招いていたのである。
【０００９】従来、これらの問題を解決する手段として、電極上への導電性異物付着による電極ショート防止、更には基板の焦電性による温度変化時における電極の静電破壊防止を目的に、櫛歯状の励振電極等の電極上に絶縁性あるい半導電性の保護膜を形成する方法が提案されていた（例えば、特願平８－３２０５２１号）しかしながら、上記方法では図９に示すように、圧電基板５１上に形成された櫛歯状の励振電極５２の電極指５２ａ上及び電極指間５３は十分な膜厚の保護膜５４が形成されるが、電極指５２ａの側面部５５は非常に薄い保護膜しか形成できず、場合によっては局所的にしか繋がって

いない保護膜となっていたり、完全に段切れしているような保護膜となっていた。これは、蒸着法やステップカバレージが比較的良好とされるスパッタ法等の成膜方法においても成膜粒子の付着する方向依存性が大きく、基板５１上面や電極指５２ａ上面に比べ電極指５２ａの側面部５５は保護膜が成膜し難いためである。

【００１０】

【発明が解決しようとする課題】このように従来方法では、電極指側面部における保護膜のカバレージが悪いため、電極指間（隙間）に導電性異物が付着すると電極指間のショートが発生し、保護膜の無いものよりは効果のあるものの、十分な導電性異物付着時の特性劣化防止とはなっていないという問題があった。

【００１１】また、上述した電荷の不均一分布に起因して発生する電極指間の放電によるフィルタ特性の劣化等を防止するために、発生した電荷の不均一分布を緩和させる目的で半導電性の保護膜を形成した場合においても、半導電性の保護膜が電極側面部で十分に繋がっていないため、電極側面部での保護膜の導電性が悪く、電荷の不均一分布を緩和させる効果が小さくなりフィルタ特性の劣化を十分に防止できないという問題があった。

【００１２】上記問題を解決する手段として、保護膜を厚く成膜する方法も考えられるが、電極上の保護膜を厚くすると損失等フィルタ特性への劣化が大きくなり実用的でない。

【００１３】本発明はこのような課題に対処するためになされたもので、導電性異物付着による電極ショート等の劣化が無く、圧電基板のもつ焦電性に起因する電極指間の放電による特性劣化の無い信頼性の非常に優れた弾性表面波装置を提供することを目的とする。

【００１４】

【課題を解決するための手段】上記目的を達成する本発明の弾性表面波装置は、圧電基板上に櫛歯状の励振電極を設けて成る弾性表面波装置において、励振電極の電極指間に絶縁性または半導電性の電極指間膜を形成し、励振電極上及び電極指間膜上に絶縁性または半導電性の保護膜を形成したことを特徴とする。

【００１５】また、励振電極及び電極指間膜を圧電基板上に形成した金属膜を選択的に陽極酸化せしめて形成したことを特徴とする。

【００１６】また、本発明の弾性表面波装置の製造方法は、圧電基板上に絶縁膜または半導電性膜を形成する工程と、絶縁膜または半導電性膜上にフォトレジストパターンを形成する工程と、該フォトレジストパターンをマスクとして絶縁膜または半導電性膜をパターニングして電極指間膜を形成する工程と、フォトレジストパターン上及び圧電基板上に金属膜を形成する工程と、フォトレジストパターンを除去することにより金属膜から成る励振電極を形成する工程と、少なくとも励振電極上及び電極指間膜上に絶縁性または半導電性の保護膜を形成する工程とを含むことを特徴とする。

【００１７】また、圧電基板に金属膜を形成する工程と、金属膜上にフォトレジストパターンを形成する工程と、該フォトレジストパターンをマスクとして金属膜をパターニングして励振電極を形成する工程と、圧電基板上及びフォトレジストパターン上に絶縁膜または半導電性膜を形成する工程と、フォトレジストパターンを除去して絶縁膜または半導電性膜から成る電極指間膜を形成する工程と、少なくとも励振電極上及び電極指間膜上に絶縁性または半導電性の保護膜を形成する工程とを含むことを特徴とする。

【００１８】なお、絶縁性または半導電性とは例えば比抵抗値が10^{-3}Ωcm以上のものとする。また、上記弾性表面波装置において、保護膜形成の前に電極間に電極膜厚と略同等の膜厚をもつ膜（電極間膜）を形成することにより、その後の保護膜形成時の電極側面のカバレージを向上させることができる。

【００１９】

【発明の実施の形態】以下、本発明に係わる実施の形態について図面に基づき詳細に説明する。図１に示すように、本発明の弾性表面波装置Ｓは、例えば直列接続された複数の弾性表面波共振器１と並列接続された複数の弾性表面波共振器２とから構成されているが、特にこのようなラダー型フィルタに限定されるものではなく、例えばラティス型フィルタ等でもよく、各種形状、接続態様のＳＡＷフィルタやＳＡＷレゾネータ等に適用可能である。

【００２０】図１の弾性表面波装置Ｓは、複数の直列接続された弾性表面波共振器１でもってローパスフィルタを構成し、並列接続された弾性表面波共振器２でもってハイパスフィルタを構成して所望の特性を得るものである。

【００２１】また、図２に示すように、弾性表面波共振器１及び２は、それぞれタンタル酸リチウム単結晶、ニオブ酸リチウム単結晶、又は四ホウ酸リチウム単結晶などの圧電基板（以下、単に基板ともいう）３上に、アルミニウムやアルミニウムを主成分とする合金（Ａｌ－Ｓｉ系，Ａｌ－Ｃｕ系，Ａｌ－Ｔｉ系等）から成る櫛歯状の励振電極であるＩＤＴ電極４を配置するとともに、ＩＤＴ電極４の両端にＩＤＴ電極４と同様な材質から成る反射器５をそれぞれ配置しており、波長λの弾性表面波をＸ方向に伝搬させるようにしたものである。なお、図２では簡単のため、ＩＤＴ電極４及び反射器５を明確に示すために、後記する電極指間膜や保護膜を省略している。

【００２２】また、図３及び図４にＩＤＴ電極４の部分断面図に示すように、圧電基板３上の少なくともＩＤＴ電極４の電極指４ａ間に例えば比抵抗値が10^{-3}Ωcm以上の絶縁性または半導電性の電極指間膜６を形成した後、絶縁性あるいは半導電性の保護膜７が少なくとも電

極領域に被着形成されている。

【００２３】このように、保護膜７を被着形成する前に、電極間にＩＤＴ電極膜厚と略同等の膜厚をもつ電極指間膜６を被着形成することにより、その後の保護膜７の形成時の電極側面部のカバレージを向上させることができる。そしてこれにより、導電性異物付着による電極ショート等の劣化が無く、圧電基板３のもつ焦電性に起因する電極指間の放電による特性劣化の無い、信頼性の非常に優れた弾性表面波装置を実現させることができる。

【００２４】図３は、電極指間膜６を両側の電極指４ａと密着させて形成した後、保護膜７を電極領域に被着形成したものである。使用される圧電基板３が例えば四ほう酸リチウム結晶基板のように焦電性がほとんど無い場合は、電極指間への導電性異物付着による電極ショートの防止が保護膜７の役割となるため、電極指間膜６及び保護膜７は半導電性である必要は無く、絶縁性とすることができる。

【００２５】また、使用される圧電基板３が例えばニオブ酸リチウム結晶基板，タンタル酸リチウム基板のように焦電性を有する基板の場合は、電極指間膜６は絶縁性または半導電性のいずれでもかまわないが、少なくとも保護膜７を半導電性膜とすることにより、温度変化等により電極指間に発生する電荷分布の不均一を緩和させ、放電によるフィルタ特性の劣化等を防止できる。

【００２６】電極指４ａと電極指間膜６を密着した構造は、金属薄膜の選択的な陽極酸化により容易に実現できるが、この場合は電極指間膜６が金属酸化物となるため絶縁膜を電極指間膜６とするときに有効な方法である。特に、一層の金属膜から電極指４ａ及び電極指間膜６を形成するため、保護膜７の成膜前の平坦性に優れ、非常に良好な被覆性で保護膜７を形成することができる。

【００２７】上記陽極酸化による金属酸化物の形成は、例えば、図５（ａ）～（ｃ）に示すような方法で行う。すなわち、図５（ａ）に示すように電解液１１を満たした容器１２の中に金属薄膜４０とパターニングされたフォトレジスト（フォトレジストパターン）８が形成された基板３を浸漬し、直流電源１３の陰極に基板３上の金属薄膜４０を、陽極には白金等の金属電極１４をそれぞれ接続し、基板３と対向させる。そして、直流電流を通電することにより、基板３上の金属薄膜４０上のフォトレジストレジスト８により被覆されていない領域の酸化を行い、図５（ｂ）に示すような酸化膜からなる電極指間膜６を形成する。その後、図５（ｃ）に示すように蒸着等により例えば半導電性膜の成膜を行い、保護膜７を形成する。

【００２８】なお、電極設計，圧電基板の種類，使用環境によっては、電荷不均一による放電の発生し易い場合がある。この場合は電極指間膜６も半導電性膜とすることにより、保護膜７のみを半導電性膜とするよりも、放電による特性劣化に対し更に高い防止効果が期待できる。

【００２９】なおまた、図３の構造において、電極指間膜６を半導電性膜とする場合は、例えば図８に示すようにフォトリソグラフィーとエッチングを２回繰り返すことによって実現できる。すなわち、図８に示すような製造工程で実現できる。まず、図８（ａ）に示すように、圧電基板３上に金属膜４０を形成し、その上にパターニングしたフォトレジスト８を形成する。次に、図８（ｂ）に示すように、フォトレジスト８で覆われていない金属膜を除去し、さらに、図８（ｃ）に示すようにフォトレジスト８を除去してＩＤＴ電極４を形成する。そして、図８（ｄ）に示すように、圧電基板３上、及びＩＤＴ電極４上に半導電性膜６０を被着形成し、図８（ｅ）に示すように全面にフォトレジスト８を形成した後に、図８（ｆ）に示すように、フォトリソグラフィーにより選択的に半導電性膜６０上のフォトレジスト８を除去する。そして、図８（ｇ）に示すように、選択的に残されたフォトレジストをマスクとしてドライエッチング等を行うことにより、ＩＤＴ電極４上の半導電性膜６０を除去し、次いで、図８（ｈ）に示すように、フォトレジスト８を除去して、図８（ｉ）に示すように、全面に半導電性の保護膜７を形成する。しかしながら、この方法はプロセスが複雑になるとともに、高精度なフォトマスクの位置合わせと高精度のエッチング技術が必要となる。

【００３０】そこで、図６に示すように、電極指間膜をフォトレジストパターンをマスクとしてエッチングにより形成した後、同じフォトレジストパターンを用いリフトオフ法にてＩＤＴ電極の電極指の形成を行い、最後に保護膜を電極領域全面に形成することにより図４の構造の弾性表面波装置を容易に得ることができる。

【００３１】すなわち、まず、図６（ａ）に示すように、圧電基板３の一主面に蒸着等により半導電性膜６０を成膜した後、フォトレジスト８を全面に塗布し、フォトリソグラフィーによりフォトレジスト８のパターニングを行う。次に、図６（ｂ）に示すように、ウエットエッチングあるいはドライエッチングにより、フォトレジスト８の被覆部以外の半導電性膜６０を除去し電極指間膜６を形成する。次に、図６（ｃ）に示すように金属膜４，４０の形成を蒸着法等により行い、しかる後に、フォトレジスト８の剥離とともにフォトレジスト８上の金属膜４０を除去し、電極指間膜６どうしの間にＩＤＴ電極４（電極指）を形成する。そして、図６（ｄ）に示すように、圧電基板３上及び励振電極４上、及び半導電性の電極指間膜６上に保護膜７を蒸着法等により形成する。

【００３２】このように、非常に簡便な製造方法となるのは、エッチング法とリフトオフ法を組み合わせることにより、電極指と電極指間膜のパターニングを１回のフ

ォトリソグラフィーで行うことができ、電極指と電極指間膜の位置合わせがセルフアライメント方式となるためである。

【００３３】電極指をリフトオフ法にて作製するために、その前段階のエッチングによる電極指間膜形成時においては、図6（ｂ）に示すようにマスクとなるレジストの幅より電極指間膜の幅を０．１ミクロン程度以下に小さくする必要がある。

【００３４】これにより、電極指と電極指間膜の間には、０～０．１ミクロン程度の間隙が生じるが、保護膜４の厚みが０．０２～０．０７ミクロン程度であるので十分間隙を埋めることができ、段切れのない良好な保護膜を形成することが可能である。

【００３５】図7は、電極指をエッチングにより形成し、電極指間膜をリフトオフ法にて形成する製造方法であり、原理的には図6の場合と同じである。

【００３６】すなわち、まず、図7（ａ）に示すように、圧電基板３上に金属膜４０を全面に被着形成し、その後、パターニングしたフォトレジスト８形成する。次に、図7（ｂ）に示すように、金属膜４０のフォトレジスト８で覆われていない領域をエッチング除去し、櫛歯状のＩＤＴ電極４を形成する。そして、図7（ｃ）に示すように、フォトレジスト８上、及び圧電基板３上に半導電性膜６，６０を形成して、電極指間膜６を形成する。さらに、フォトレジスト８をリフトオフ法で除去することにより図7（ｄ）に示すように、ＩＤＴ電極４上、電極指間膜６上及び図示していないが圧電基板３上に保護膜７を形成する。

【００３７】図6，図7に示す製造方法において、電極指間膜及び保護膜がそれぞれ独立に絶縁膜あるいは半導電性膜で形成可能であることは自明である。

【００３８】このような電極指間膜及び保護膜に用いられる絶縁膜としては、酸化シリコン，窒化シリコン，酸化アルミニウム等の酸化物あるいは窒化物を用いることができる。また、半導電性膜としては比抵抗と電極膜厚の比（比抵抗値／電極膜厚）が10^{9} ～10^{13}Ωの材料が望ましく、シリコン膜（比抵抗　5×10^{5} Ω・ｃｍ程度）がよく用いられる。

【００３９】このようにして、導電性異物付着による電極ショート等の劣化が無く、圧電基板のもつ焦電性に起因する電極指間の放電による特性劣化の無い信頼性の非常に優れた弾性表面波装置を簡便な製造方法で提供することができる。

【００４０】なお、弾性表面波装置は上記の形態や製法に限定されるものではなく、圧電基板上に励振電極等の電極が配設され、励振電極の電極指間に絶縁性または半導電性の電極指間膜が形成され、さらに、少なくとも励振電極上及び電極指間膜上に保護膜が形成されていればよく、圧電基板、励振電極、電極指間膜、及び保護膜等の材質についても上記のものに限定されず、要旨を逸脱しない範囲で適宜変更し実施が可能である。

【００４１】

【実施例】〔例１〕まず、図3に示すような構成の実施例について説明する。３６°ＹカットＸ伝播タンタル酸リチウムの直径３～４インチ程度の圧電基板の一方の面に、アルミニウムやアルミニウム合金等の金属薄膜を蒸着，スパッタ等の方法を用いて厚さ２０００～５０００Å程度に形成し、その後フォトレジストを金属薄膜の形成された圧電基板上に厚さ１～１．５μｍ 程度に塗布した。しかる後に、電極パターンが形成可能なフォトマスクを用いて紫外光等により露光を行った。

【００４２】次に、有機アルカリ系の現像液に浸漬し、フォトレジストのパターニングを行い、次に、図5（ａ）に示すように、電解液１１を満たした容器１２の中に基板３を浸漬した。直流電源１３の陰極に基板３上の金属薄膜４０を接続し、陽極には白金等の金属電極１４を接続し、基板３と対向させた。そして、電流密度０．１～２Ａ／dm^{2} 程度の直流電流を通電することにより、基板３上の金属薄膜４０上のフォトレジストレジスト８により被覆されていない領域の酸化を行い、図5（ｂ）に示すような酸化アルミニウムまたはアルミニウム合金の酸化膜からなる電極指間膜６を厚さ２０００～５０００Å程度に形成した。

【００４３】ここで、電解液１１には、エチレングリコールと四ほう酸アンモニウムからなる溶液，硫酸，クロム酸等を用いた。その後、図5（ｃ）に示すように蒸着等によりシリコン膜を厚さ２００～７００Å程度の成膜を行い、保護膜７を形成した。

【００４４】次に、フォトリソグラフィー等による部分的なエッチングによりワイヤーボンディングパッド部の保護膜を除去し、その後、ダイシング，ダイボンド，ワイヤーボンド，封止等のパッケージへの実装工程を経てＳＡＷフィルタを完成した。このＳＡＷフィルタは挿入損失が少なく非常に良好であり、またチップ状態で導電性ペーストに浸漬・乾燥した後の特性評価においても全く特性に劣化が見られず、保護膜としての機能を十分に発揮できた。さらに、組立工程等の急激な温度変化によっても劣化が見られず、放電による特性劣化を完全に防止できた。

【００４５】〔例２〕次に、図4に示すような構成の実施例について説明する。図6（ａ）に示すように、３６°ＹカットＸ伝搬タンタル酸リチウム単結晶の圧電基板３の一方の面に、蒸着等によりシリコン膜６０を厚さ２０００～５０００Å程度に成膜した後，フォトリソグラフィーによりフォトレジスト８のパターニングを行った。

【００４６】次に、図6（ｂ）に示すように、フッ酸・硝酸系のウエットエッチングあるいは弗化炭素（CF_{4} ）等によるドライエッチングにより、フォトレジスト８の被覆部以外のシリコン膜を除去し電極指間膜６を

厚さ２０００～５０００Å程度に形成した。

【００４７】次に、図６（ｃ）に示すようにアルミニウムまたはアルミニウム合金の成膜２，２０を行い、フォトレジスト８の剥離とともにフォトレジスト８上のアルミニウム膜４０を除去し、電極指間膜６どうしの間にＩＤＴ電極４（電極指）を厚さ２０００～５０００Å程度に形成した。その後は、上記例１と同様にしてシリコン保護膜７を形成し、実装工程を経てＳＡＷフィルタを完成させた。このＳＡＷフィルタも例１と同様な効果が得られた。

【００４８】

【発明の効果】以上詳述したように、本発明の弾性表面波装置によれば、導電性異物が付着しても電極ショート等の劣化が全く無く、圧電基板のもつ焦電性に起因する電極指間の放電による特性劣化も全くない、信頼性の非常に優れた弾性表面波装置を簡便かつ迅速な製造方法で提供することができる。

【００４９】また、電極指間膜を陽極酸化により形成すれば、一層の金属膜から電極指及び電極指間膜を同時に形成することができ、迅速に製造できるだけでなく、保護膜形成前の平坦性が良好となるので、好適な被覆性を実現した保護膜を有した、信頼性の非常に優れた弾性表面波装置を提供できる。

【図面の簡単な説明】

【図１】本発明に係る一実施例の弾性表面波装置を模式的に説明する回路図である。

【図２】本発明に係る弾性表面波装置を構成する弾性表面波共振器を模式的に説明する概略平面図である。

【図３】本発明に係る弾性表面波装置の一実施形態を模式的に説明する図であり、図２におけるＡ－Ａ線部分断面図である。

【図４】本発明に係る弾性表面波装置の他の実施形態を模式的に説明する部分断面図である。

【図５】（ａ）～（ｃ）はそれぞれ本発明の一製造方法を模式的に説明する部分断面図である。

【図６】（ａ）～（ｄ）はそれぞれ本発明の他の製造方法を模式的に説明する部分断面図である。

【図７】（ａ）～（ｄ）はそれぞれ本発明の他の製造方法を模式的に説明する部分断面図である。

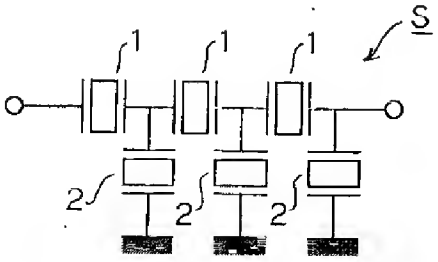
【図８】（ａ）～（ｉ）はそれぞれ本発明と比較するための製造方法を模式的に説明する部分断面図である。

【図９】従来の弾性表面波装置の一例を模式的に説明する部分断面図である。

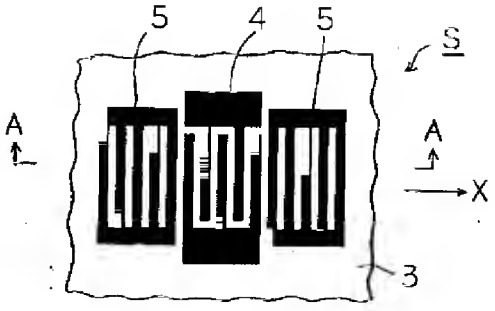
【符号の説明】

１：弾性表面波共振器（直列用）
２：弾性表面波共振器（並列用）
３：基板（圧電基板）
４：ＩＤＴ電極（励振電極）
４ａ：電極指
５：反射器
６：電極指間膜
７：保護膜
８：フォトレジスト
４０：金属膜
Ｓ　・・・　弾性表面波装置

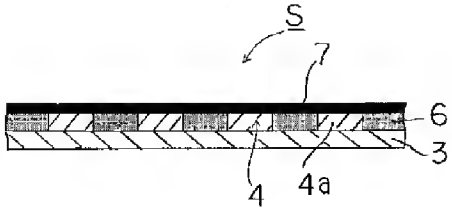
【図１】



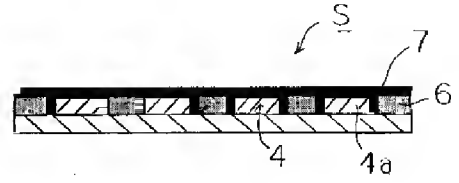
【図２】



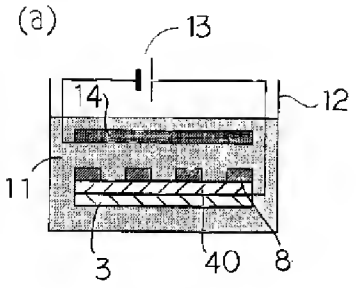
【図３】



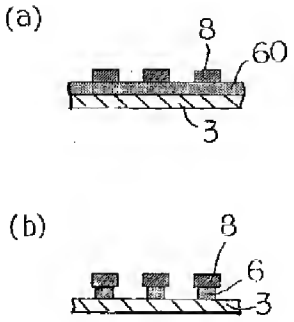
【図４】



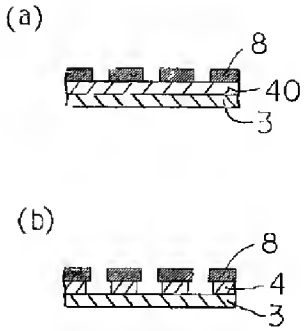
【図5】


(a)
13
14
12
11
3
40
8
(b)
8
4
6
3
(c)
7
4
6
3

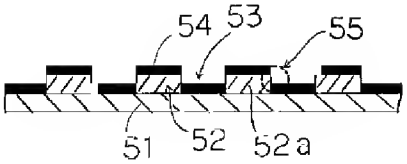
【図6】


(a)
8
60
3
(b)
8
6
3
(c)
40
8
3
6
(d)
7
4
6
3

【図7】


(a)
8
40
3
(b)
8
4
3
(c)
60
8
4
6
3
(d)
7
4
3
6

【図9】


54
53
55
51
52
52a

【図8】